

U.S. Patent Application No. 09/504,623
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ferromagnetic region. Further, the Office Action indicates that regarding claim 2, Schwarzacher discloses the channel region includes nanotube, referring to Fig. 14, page 3133 Paragraph 3. These rejections are respectfully traversed.

Schwarzacher shows in Fig. 14 the superlattice comprising alternate layers of Cu and Co built up in pores of polycarbonate substrate. The diameter of the nanowires is of the order of 40 nm, which in the context of the present invention, is a relatively large diameter. The alternate Cu and Co layers constitute non-ferromagnetic and ferromagnetic layers respectively, so that in the presence of a magnetic field, the current that flows along the wire depends upon the applied field strength and in particular whether the magnetic domains of the individual ferromagnetic layers are aligned in parallel or antiparallel

In contrast, the presently claimed invention includes a channel region provided between the first and second fereromagnetic regions, the channel region configured to provide a quasi-one-dimensional channel to cause charge carriers that pass through the first ferromagnetic region to maintain their spin polarization as they pass towards the second ferromagnetic region. As recited in claim 2, the channel region may be a nanotube. According to the Office Action analysis, the Cu layers in Fig. 14 of Schwarzacher perform the recited function of the quasi-one-dimensional channel. However, this is incorrect. The diameter of the nanowire of Schwarzacher is too large to provide a quasi-one-dimensional channel that is capable of maintaining the spin polarization of charge carriers and furthermore, there is no enabling disclosure of such a process. The nanowire of Schwarzacher is in fact a conventional superlattice that exhibits GMR with alternate ferromagnetic and non-ferromagnetic layers.

Further, the nanowire of Schwarzacher is not a nanotube as recited in claim 2. The average diameter of a single walled nanotube is on the order of 1.2 to 1.4 nm, in contrast to the 40nm diameter wire of Schwarzacher, as shown in the attached reference one. Further, attached reference 2 shows that “nanotube” is a well-known term of art. From these references, it can be seen that the diameter of a nanotube is much smaller than the nanowire of Schwarzacher. Further, as explained above, a quasi-one-dimensional channel which can maintain the spin polarization as recited in claim 1 cannot be achieved by the use of a nanowire having a 40nm diameter as disclosed in Schwarzacher. If the Examiner disagrees

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with this, it is incumbent upon the Examiner to demonstrate that the teachings of Schwarzacher would result in a quasi-one-dimensional channel.

For at least the above reasons, it is submitted that neither claims 1 or 2, nor any of the claims dependent therefrom, are anticipated by Schwarzacher. Withdrawal of the rejection is requested.

The Office Action also rejects claims 1, 18-20 and 22 under 35 USC § 103 over Johnson (USP 5,654,566) in view of Schwarzacher. The Office Action asserts that it would be obvious to include the nanowire of Schwarzacher into the magnetic spin injected FET structure disclosed by Johnson. The Office Action asserts that a person of ordinary skill in the art would be motivated to provide a quasi-one-dimensional channel to achieve much higher magnetoresistance in greater compactness. These assertions are respectfully traversed.

As explained above, Schwarzacher does not disclose a quasi-one-dimensional channel capable of conserving the spin of electrons. Instead, the nanowire of Schwarzacher is itself a conventional GMR multilayer structure and so there would be no motivation to include it in the device of Johnson.

As explained in the previous response, Johnson uses a 2DEG for its channel. There would be no motivation to replace the 2DEG channel by a bulk GMR multilayer material as disclosed by Schwarzacher, particularly because it would be difficult to deposit, the multilayers of Schwarzacher would have to be laid down orthogonally to the substrate of Johnson and it is not evident that the gate of Johnson could be used to control the operation of the device if GMR multilayers according to Schwarzacher were used instead of the 2DEG. Indeed, it is not evident that the resulting device would operate at all.

Thus, it is submitted that the Office Action has artificially spit the invention into two parts corresponding to the disclosures of Johnson and Schwarzacher, and has not considered the two cited references as a whole. There is nothing in either of the references that indicates the desirability and obviousness of combining them both together and indeed it is not evident that the resulting combination would actually work. Thus, there is no reasonable expectation of success when including the bulk GMR material of Schwarzacher, even as a nanowire, into the device of Johnson. It is submitted that the Examiner has impermissibly made use of hindsight to combine these two references. Further, as pointed out above, even if combined,

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the cited references would not result in the claimed invention since Schwarzacher does not disclose or suggest a quasi-one-dimensional channel as required by claim 1 of the present application.

For at least the above reasons, it is submitted that the combination of Johnson and Schwarzacher would not result in the claimed invention, and that there would be no motivation to combine the references as asserted. Accordingly, Applicants request withdrawal of the rejection of the claims under 35 USC over Johnson in view of Schwarzacher.

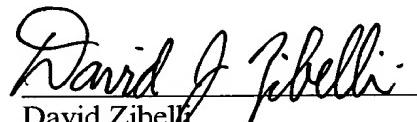
The Office Action also rejects various dependent claims over Schwarzacher in view of additional references. It is respectfully submitted that these rejections are rendered moot by the fact that claim 1 is allowable over the cited prior art. Withdrawal of the rejections is requested.

For at least the above reasons, it is submitted the application is in condition for allowance. Prompt consideration and allowance are solicited.

The Office is authorized to charge any fees due under 37 C.F.R. § 1.16 or 1.17 to Deposit Account No. 11-0600.

Should there be any questions concerning this matter, the Examiner is invited to contact Applicants undersigned attorney.

Respectfully submitted,



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Attachments: Attachment 1 and Attachment 2

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